A Scalable Semi-Submersible Platform Utilizing Wave Energy Conversion and Shared Mooring for Floating Offshore Wind Turbine Farms (FOWT)

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Further optimization of renewable energy systems is crucial for efforts towards developing a sustainable future. Recently, offshore wind has become one of the most rapidly advancing solutions. Experimentation rationale is largely based upon the room for improvement in the field. 19 total floating offshore wind turbines are currently being tested, all of which utilize a barge, spar, or semi-submersible system. This experiment utilizes a semi-submersible platform in combination with two engineered systems: wave energy conversion, and shared mooring. These systems were created to effectively reduce overall cost of the turbine while supplying excess supplemental power and upkeep. OpenFAST, an open-source offshore turbine simulation software, and variables from the open-source NREL OC4-DeepCWind turbine were used to accurately simulate the turbine accompanied by the engineered systems. A python script was written to randomize wind and wave patterns and run simulations for a total of 100 trials over 16 hours. The OpenFAST python toolbox was utilized to format expansive data tables into interpretable graphs to determine system stability and power output. A second python script was used to average data from the output graphs. It was concluded that the shared mooring system caused the platform to remain stable, as surge and pitch values fluctuated by a margin of 10m and 3.5° respectively. After cost-analysis, the shared mooring system cut mooring costs by up to 50% in a 3x3 & 4x4 farm scenario. Additionally, the wave-energy conversion system successfully increased overall power output by 750kW (18%), bringing total power output to around 5.5mW.

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